An astrolabe of Gualterus Arsenius and some gnomonic instruments found in the warehouses of Ursino Castle in Catania (Sicily)

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Abstract: In autumn 2014, during an exploration in the warehouses of Ursino Castle in Catania (Sicily), I found some instruments of astronomy and gnomonic of considerable scientific and historical value, and undoubted artistic beauty. Among them there is the 1566 astrolabe by *Gualterus Arsenius*, one of the most important Flemish builders of the Renaissance period, nephew of *Gemma Frisius*, the Dutch mathematician and cosmographer who taught at the University of Louvain (Belgium). With the rediscovered instrument from Catania the number of astrolabes of Arsenius rises to 28. In addition to the "Catania's astrolabe", another fifteen objects were found, including: 7 gnomonic instruments signed by the Catania canonical *Stanislao Scoto* (XVIII century), 2 topographic compasses (XVI - XVIII centuries), 1 shepherd's watches, 1 sundial with pocket compass, 2 cubic solar watches signed by David Beringer (end of the XVIII century) and 1 refractive solar clock (probably second half of the XVI century).

Keywords: Astrolabe, Gualterus Arsenius, Ursino Castle, 1566, Biscari Prince, Catania, gnomonic and ancient astronomy, ancient instruments.

1. The discovery of the Arsenius astrolabe

1.1. Introduction

It was the autumn of 2014 when I was exploring the warehouses of the Ursino Castle, and opening a hidden and dusty drawer of a large shelving I found myself in my hands a "brass plate", a magnificent blackened artefact with inscriptions and stellar, gnomonic and topographical references; it was an indescribable emotion, I immediately realized that I had found an ancient astrolabe. An instrument that from now on can be called the "Catania's astrolabe"[1] (Fig. 1).

[1] I want to thank first of all Drs. *Valentina Noto*, director of the Ursino Castle, and all her staff for the exquisite availability and assistance received during the numerous study days spent in the warehouses of the Swabian manor. Special thanks go to the photographer *Paolo Conti* and to the restorers *Roberta Ventimiglia di Monteforte* and *Catherine Lemercier*, who have cleaned and restored half of the tools found. Thanks also to the professionals of Officine Culturali, and in particular to Dr. *Francesco Mannino* and Drs. *Manuela Lupica*, for having shared the design idea of the exhibition which will be discussed at the end of this article, and to Prof. *Giovanni Strazzulla*, an astronomer and former director of the Catania Astrophysical observatory, for having always supported with great enthusiasm my study on the discovery collection.

Fig. 1. The author with the Arsenius astrolabe found in the Ursino Castle's warehouses (photo by Paolo Conti).

The astrolabe is an astronomical instrument used in the Middle Ages and the Renaissance for astronomical use, mainly to calculate the position of celestial bodies such as the stars, the Moon and the Sun (Orlando 2018). But the measurements provided by the astrolabe also concern other numerous fields of investigation, such as topography, astrology, chronometry and geometry. The astrolabe was the scientific instrument par excellence, emblem of the science of time (Hoskin 2009). The first specimens were built at the end of XI century in the Middle East and, according to Islamic historical sources, *Ibrahim al-Fazārī* was the first Arab astronomer and mathematician to deal with the astrolabe; in this historical period the centers of greatest production of astrolabes were the cities of Harran and Baghdad (Bonoli 2003). In the Renaissance, the construction of astrolabes in Europe reached its peak with the School of Louvain, a small town in Flanders, home to the oldest university in Belgium (Van Cleempoel 2002).

The plane astrolabe is generally composed of 5 parts (Trento 2009): 1) the body or *mater* of the astrolabe, a disc which is bordered by a circular crown called the *margin* o flap; 2) the mother houses the *tympans* or laminae, generally up to a maximum of nine; 3) the *rete* or arachnoe, positioned above the tympans; 4) the *ruler*, positioned above the rete, and the *alidade* that is placed on the back of the astrolabe; 5) these elements are held together by a *pin* which is usually drilled to fit a locking *horse*.

Finally, a *junction*, formed by a ring, is used to hold the instrument suspended while using it for observations.

1.2. Description of the found astrolabe

The "Catania's astrolabe" has not come down to us in all its parts, in fact the ruler, the horse, the alidade and the complete set of tympans are missing. However, even if incomplete, the astrolabe found in the warehouses of Ursino Castle remains an instrument of great scientific and historical importance, and of undoubted artistic beauty. Now I want to describe this masterpiece of the Renaissance era. First of all, on the up-per part of the mater's margin, just below the *throne*, there are the name of the author and the year of production: *Gualterus Arsenius Gemma Frisy Nepos Louany fecit 1566*.

On this astrolabe, as well as on all the instruments he built, Arsenius signs *nepos*, that is nephew, of *Gemma Frisius,*[2] the Flemish mathematician and cosmographer who taught mathematics and medicine at the University of Louvain.

The influence of Frisius is quite evident on the astrolabes made by Arsenius. For example, the astrolabe of Catania bears on its back a particular type of projection already conceived by the Arab astronomer *al-Zarqālī*[3] in the XI century and re-proposed by Frisius. It is a universal stereographic projection that allowed the use of the astrolabe at any latitude, hence the designation proposed by Frisius of the *Catholic astrolabe*, in association with the universality of the Catholic faith.

As for the *rete* of the astrolabe of Catania it presents the typical invoice of the Flemish school of Leuven: in it are found in fact engraved forty two stars indicated by 'snakes' (artistic pointers) and, inside the ecliptic, the classic *tulip* that is delineated between the intertwining brass. An astrolabe built by *Gerardus Mercator*[4] in 1545[5] is the first astrolabe to present this stylistic peculiarity (Turner 1994), which is then found in all the astrolabes of Leuven. Moreover, the fluid style of the incisions of the astro-labe of Catania, almost all in italics, is another of the characteristics of the instruments of Leuven that was introduced by Mercator.[6]

,[2] *Rainer Gemma Frisius* (1508-1555) can be considered the founder of the Dutch geographic school; Frisius was a master of Gerardus Mercator and the most ancient treatment of the principles of triangulation dates back to him.

[3] *Abū Isḥāq Ibrāhīm ibn Yaḥyā al-Naqqāsh al-Zarqālī* (1029-1087), known in the West also as *Arzachel*, was an Arab astronomer and astrologer famous for having compiled the 'Tables of Toledo'. His name is also linked to a new and more functional astrolabe: the *universal astrolabe*, later called by the European writers *asaphea* or saphaea, from the Arabic aṣ-ṣafīḥah "the lamina".

[4] *Gerardus Mercator* (1512-1594), Flemish cartographer, mathematician and astronomer; he is famous for having introduced a new cartographic projection system that takes his name. At the University of Louvain he attended the lessons of Gemma Frisius.

[5] This astrolabe is kept at the Moravska Galerie (Brno, Czech Republic).

[6] In 1540 Mercator published a treatise on the correct and consistent use of the italics, which immediately proved to be very useful for cartographers and builders of scientific instruments, offering ideal characteristics for writing clearly and elegantly in small spaces. The Mercator's manual *Literarum latinarum, quas Italicas cursoriasque vocant, scribendarum ratio* was widely followed, by Dutch cartographers for example, and the astrolabes of Louvain were the first to be engraved with cursive characters.

The astrolabe of Catania is equipped with a *tympan* (diameter 312 mm) set in the mother of the instrument. In general, the tympans allowed to perform different calculations and measurements for a given latitude; in the case of the only tympan of the astrolabe of Catania the latitude is of 43° and 50'. The tympan is engraved on both sides. The *throne* consists of two reclining satyrs, male on the left and female on the right, which flank a central shield that incorporates a compass. The throne is mounted on a curved bar attached to the disk by two screws with octagonal heads. The pivot *pin* and the suspension *ring* are present.

The *mater* of the astrolabe has a diameter of 340 mm. The mater's margin is characterized by several graduated scales, essentially linked to the measurement of decigrades, degrees and hours. On the inside of the front of the astrolabe's mater a quadratum nauticum is engraved with the cardinal directions and the names of the winds.

In the back of the astrolabe there is a universal stereographic projection, that is, it can be used at any latitude, a system based on the projection of the celestial sphere described in Frisius's *De astrolabio catholic*. In the projection field there are 22 stars marked by an asterisk, of which 13 in the Northern hemisphere (*Lyra, Ursa maior (7 stars), Hircus, Caput medusae, Arcturus, Aquila and Ophiuchi but: dex*), 8 in the Southern hemisphere (*Spica ♍, Oculus ♉, Cauda ♏, Postrema aquae fusae, Canicula, Orionis finist pes, Canis maior, Canopus*) and one, the *Cor ♌*, placed on the ecliptic. The ecliptic is graded and contains the 12 signs of the zodiac.

The astrolabes built by Arsenius known until yesterday were 27 in number. With the rediscovered Catania instrument the number of astrolabes of the Flemish builder rises to 28, and Italy becomes the country to keep the largest number (6 against the 5 French). Of the other five Arsenius astrolabes present in Italy one is kept at the Specola museum in Bologna and built in 1565, one is found at the Museum of history of physics of the University of Padua, with the signature of Renerus Arsenius and built in 1566, another not signed and without date is in Castel Gandolfo (Rome), while the other two are kept at the Galileo museum in Florence, in this case they are astrolabes from the *Medici* collections, one built in 1570 and the other in 1572.

It is interesting to note that with the discovery of the Catania astrolabe it can certainly be said that in 1566 Arsenius built 3 astrolabes; the year 1566 therefore becomes a real "golden year", a year of intense production of astrolabes. In addition to the contemporary one of Padua, the other astrolabe built in 1566 is kept at the Archaeological Museum of Madrid, and it is the famous "Philip's astrolabe".[7]

The rediscovered Arsenius' astrolabe was presented to the public during the first date of the VIII edition of the cultural manifestation of astronomy and ancient music[8] held in the arms room of the Ursino Castle on January 7th, 2018.

[7] The so-called "astrolabe of Philip", with a diameter of about 60 cm, is the largest astrolabe built by Arsenius.

[8] The cultural manifestation called "*Alla ricerca dell'astronomia e della musica perduta*" was conceived by the undersigned in 2009; the scientific and artistic direction is edited by the undersigned and by the Maestro *Giuseppe Severini*.

1.3. Biscari Museum and Museum of the Benedictines in Catania

It is not possible at the moment to state whether the astrolabe of Catania was part of the collection of the Biscari museum or that of the museum of the benedictines fathers (Lupica Rinato, Orlando 2017). We know that Ignazio Paternò Castello prince of Biscari was a passionate collector, even of scientific instruments, as is amply demonstrated by the 24 delivery reports (1930) of the prince of Biscari museum to the municipality of Catania (Pafumi 2006). However, neither in the above-mentioned delivery reports nor in the inventories reached up to us, is present the astrolabe found in the warehouses of Ursino Castle.

It must be underlined that the benedictine monks were linked to the astronomical sciences also, and a clear demonstration of that is the construction of the great sundial of the *Church of San Nicolò the Arena*, built by two famous astronomers of the XIX century: the German *Wolfgang Sartorius von Waltershausen* and the Danish *Christian Peters*, who finished the works in 1841 (e.g. Lanciano, Cicciarelli 2017). In the Museum of the Benedictine Fathers we know that in the fourth room there were physical-mathematical instruments also (Bertucci 1846); unfortunately, however, even in this case, from the documents reached up to us, the astrolabe is not reported.

It would therefore seem impossible to solve the mystery of belonging to which museum or collection was part of the astrolabe of Catania. But a clue that could solve the puzzle seems to give it just a piece of the astrolabe: the surviving tympan. This piece is of great interest, in fact, as already noted above, its latitude leads one to think that it was built for someone who lived in Florence, probably for some of the *Medici Family*. We know that in the XIX century the prince of Biscari bought several pieces from antique dealers in Naples, Rome and Florence, so it could therefore be plausible the hypothesis that the "Catania's astrolabe" was bought by the prince of Biscari in Florence during one of his travels.

2. The other instruments of the rediscovered collection

Together with the Catania astrolabe there are another fifteen instruments of ancient astronomy and gnomonic found in the Ursino Castle's warehouses. Among them there are the little known collection of 7 gnomonic instruments signed by the Catania's canon Stanislao Scoto (Pafumi 2012). Scotus was a canon of the Catania's Collegiate, a character we unfortunately have very little information about: we know the date of death (March 24th, 1758) but not that of birth (Gemmellaro 1843). We also know that Scoto built these hourly quadrants in 1752, and we know that he was a craftsman also appreciated outside the Etna area, given that for the *Sant'Agata church* of Alì, a small town in the province of Messina, the canon built a clock, unfortunately lost (Di Bella 1994).

Among the instruments found there are 10 other artifacts of great scientific interest and historical importance, namely:

- 2 cubic solar watches signed by David Beringer (end of the XVIII century);
- 1 shepherd's watch (without signature or date);

- 1 refractive solar watch (without signature or date, probably from the second half of the XVI century);
- 2 compasses for reliefs (XVI century);
- 1 portable wooden sundial (without signature or date) with a heraldic crest and with the following inscription: "*Ad Elevazionem Poli Siracusam*";
- 1 sundial with pocket compass (probably XVII-XVIII centuries);
- 2 objects in wood and metal alloy, probably one of them is a graphometer (without signature or date).

3. Conclusion

The discovery of the Arsenius' astrolabe opens up new and interesting research scenarios, both in the scientific field, linked essentially to the history of astronomical instruments, and in the humanistic field, mainly related to the history of the collecting of Catania. To tell this discovery, the organization of the exhibition *Celestial mechanisms: from Arsenius to Stanislao Scoto* is planned, to be realized in one of the rooms of the Swabian manor, which I hope can be inaugurated in the next years.

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